

---

# OBSERVATIONS & RECOMMENDATIONS

After reviewing data collected from **MOUTAINVIEW LAKE, SUNAPEE** the program coordinators have made the following observations and recommendations:

## FIGURE INTERPRETATION

- **Figure 1 and Table 1:** The graphs in Figure 1 (Appendix A) show the historical and current year chlorophyll-a concentration in the water column. Table 1 (Appendix B) lists the maximum, minimum, and mean concentration for each sampling season that the lake/pond has been monitored through the program.

Chlorophyll-a, a pigment found in plants, is an indicator of the algal abundance. Because algae are usually microscopic plants that contain chlorophyll-a, and are naturally found in lake ecosystems, the chlorophyll-a concentration measured in the water gives an estimation of the algal concentration or lake productivity. **The mean (average) summer chlorophyll-a concentration for New Hampshire's lakes and ponds is 7.02 mg/m<sup>3</sup>.**

The current year data (the top graph) show that the chlorophyll-a concentration **increased very slightly** from **July** to **August**. The chlorophyll-a concentration on **each sampling event** was ***much less than*** the state mean.

Overall, the statistical analysis of the historical data (the bottom graph) shows that the mean annual chlorophyll-a concentration has ***not significantly changed*** since monitoring began. Specifically, the chlorophyll-a concentration has ***fluctuated between approximately 3 and 12 mg/m<sup>3</sup>***, but has ***not continually increased or decreased*** since **1985**. (Note: Please refer to Appendix E for the detailed statistical analysis explanation and data print out.)

While algae are naturally present in all lakes/ponds, an excessive or increasing amount of any type is not welcomed. In freshwater lakes/ponds, phosphorus is the nutrient that algae depend upon for growth. Algal concentrations may increase with an increase in

nonpoint sources of phosphorus loading from the watershed, or in-lake sources of phosphorus loading (such as phosphorus releases from the sediments). Therefore, it is extremely important for volunteer monitors to continually educate residents about how activities within the watershed can affect phosphorus loading and lake/pond quality.

- **Figure 2 and Table 3:** The graphs in Figure 2 (Appendix A) show historical and current year data for lake/pond transparency. Table 3 (Appendix B) lists the maximum, minimum and mean transparency data for each sampling season that the lake/pond has been monitored through the program.

Volunteer monitors use the Secchi-disk, a 20 cm disk with alternating black and white quadrants, to measure water clarity (how far a person can see into the water). Transparency, a measure of water clarity, can be affected by the amount of algae and sediment from erosion, as well as the natural colors of the water. **The mean (average) summer transparency for New Hampshire's lakes and ponds is 3.7 meters.**

The current year data (the top graph) show that the in-lake transparency **remained stable** from **July to August**. The transparency on **each sampling event** was **slightly less than** the state mean.

Overall, the statistical analysis of the historical data (the bottom graph) shows that the mean annual in-lake transparency has **not significantly changed** (either *increased* or *decreased*) since monitoring began. Specifically, the in-lake transparency has remained **relatively stable, ranging between approximately 3 and 4 meters**, since **1985**. (Note: Please refer to Appendix E for the statistical analysis explanation and data print out.)

Typically, high intensity rainfall causes erosion of sediments into lakes/ponds and streams, thus decreasing clarity. Efforts should continually be made to stabilize stream banks, lake/pond shorelines, disturbed soils within the watershed, and especially dirt roads located immediately adjacent to the edge of tributaries and the lake/pond. Guides to Best Management Practices designed to reduce, and possibly even eliminate, nonpoint source pollutants, such as sediment loading, are available from DES upon request.

- **Figure 3 and Table 8:** The graphs in Figure 3 (Appendix A) show the amounts of phosphorus in the epilimnion (the upper layer) and the hypolimnion (the lower layer); the inset graphs show current year data. Table 8 (Appendix B) lists the annual maximum, minimum, and median concentration for each deep spot layer and each tributary since the lake/pond has joined the program.

Phosphorus is the limiting nutrient for plant and algae growth in New Hampshire's freshwater lakes and ponds. Too much phosphorus in a lake/pond can lead to increases in plant and algal growth over time. **The median summer total phosphorus concentration in the epilimnion (upper layer) of New Hampshire's lakes and ponds is 12 ug/L. The median summer phosphorus concentration in the hypolimnion (lower layer) is 14 ug/L.**

The current year data for the epilimnion (the top inset graph) show that the phosphorus concentration **remained relatively stable** from **July** to **August**. The phosphorus concentration on **each sampling event** was **slightly less than** the state median.

The current year data for the hypolimnion (the bottom inset graph) show that the phosphorus concentration **decreased greatly** from **July** to **August**. The phosphorus concentration in **July** was **greater than** the state median and in **August** was **less than** state median.

The turbidity of the hypolimnion (lower layer) sample was **elevated** on the **July** sampling event (**3.99 NTUs**). This suggests that the lake/pond bottom may have been disturbed by the anchor or by the Kemmerer Bottle while sampling and/or that the lake bottom is covered by a thick organic layer of sediment which is easily disturbed. When the lake/pond bottom is disturbed, sediment, which typically contains attached phosphorus, is released into the water column. When collecting the hypolimnion sample, make sure that there is no sediment in the Kemmerer Bottle before filling the sample bottles.

The historical data show that the 2004 mean hypolimnetic phosphorus concentration is **slightly greater than** the state median.

Overall, the statistical analysis of the historical data shows that the phosphorus concentration in the epilimnion (upper layer) and the hypolimnion (lower layer) has **not significantly changed** since monitoring began. Specifically, the mean annual phosphorus concentration in the epilimnion has **fluctuated between 6 and 19 ug/L** but has **not continually increased or decreased** since 1985. The phosphorus concentration in the hypolimnion has **fluctuated between 6 and 24 ug/L** but has **not continually increased or decreased** since monitoring began. (Note: Please refer to Appendix E for the detailed statistical analysis explanation and data print out.)

One of the most important approaches to reducing phosphorus loading to a waterbody is to continually educate watershed residents about its sources and how excessive amounts can adversely impact the ecology and value of lakes and ponds. Phosphorus sources within a lake or pond's watershed typically include septic systems, animal waste, lawn fertilizer, road and construction erosion, and natural wetlands.

#### **TABLE INTERPRETATION**

➤ **Table 2: Phytoplankton**

Table 2 (Appendix B) lists the current and historical phytoplankton species observed in the lake/pond. Specifically, this table lists the three most dominant phytoplankton species observed in the sample and their relative abundance in the sample. In addition, this table has been enhanced this year to include the overall phytoplankton cell abundance rating of the sample. The overall phytoplankton cell abundance in a sample is calculated using a formula based on the relationship that DES biologists have observed over the years regarding phytoplankton concentrations, algal concentrations, and biological productivity in New Hampshire's lakes and ponds. A mathematical equation is used to classify the overall abundance of phytoplankton cells in a sample into the following categories: *sparse*, *scattered*, *moderate*, *common*, *abundant*, and *very abundant*. Generally, the more phytoplankton cells there are in a sample, the higher the chlorophyll concentration and the higher the biological productivity of the lake.

The dominant phytoplankton species observed in the **August** sample were ***Tabellaria* (diatom)**, ***Asterionella* (diatom)**, ***Elakatothrix* (green)**, ***Mallomonas* (golden-brown)**, and ***Ceratium* (dinoflagellate)**.

The overall abundance of rating phytoplankton cells in the sample was calculated to be ***scattered***.

Phytoplankton populations undergo a natural succession during the growing season (Please refer to the "Biological Monitoring Parameters" section of this report for a more detailed explanation regarding seasonal plankton succession). Diatoms and golden-brown algae are typical in New Hampshire's less productive lakes and ponds.

➤ **Table 2: Cyanobacteria**

A **small amount** of the cyanobacterium *Anabaena* and *Microcystis* were observed in the plankton sample this season. ***These species, if present in large amounts, can be toxic to livestock, wildlife, pets, and humans.*** (Please refer to the “Biological Monitoring Parameters” section of this report for a more detailed explanation regarding cyanobacteria).

Cyanobacteria can reach nuisance levels when phosphorus loading from the watershed to surface waters is increased (this is often caused by rain events) and favorable environmental conditions occur (such as a period of sunny, warm weather).

The presence of cyanobacteria serves as a reminder of the lake's/pond's delicate balance. Watershed residents should continue to act proactively to reduce nutrient loading to the lake/pond by eliminating fertilizer use on lawns, keeping the lake/pond shoreline natural, re-vegetating cleared areas within the watershed, and properly maintaining septic systems and roads.

In addition, residents should also observe the lake/pond in September and October during the time of fall turnover (lake mixing) to document any algal blooms that may occur. Cyanobacteria have the ability to regulate their depth in the water column by producing or releasing gas from vesicles. However, occasionally lake mixing can affect their buoyancy and cause them to rise to the surface and bloom. Wind and currents tend to “pile” cyanobacteria into scums that accumulate in one section of the lake/pond. If a fall bloom occurs, please collect a sample (any clean jar or bottle will be suitable) and contact the VLAP Coordinator.

➤ **Table 4: pH**

Table 4 (Appendix B) presents the in-lake and tributary current year and historical pH data.

pH is measured on a logarithmic scale of 0 (acidic) to 14 (basic). pH is important to the survival and reproduction of fish and other aquatic life. A pH below 6.0 limits the growth and reproduction of fish. A pH between 6.0 and 7.0 is ideal for fish. The mean pH value for the epilimnion (upper layer) in New Hampshire's lakes and ponds is **6.6**, which indicates that the surface waters in the state are slightly acidic. For a more detailed explanation regarding pH, please refer to the “Chemical Monitoring Parameters” section of this report.

The mean pH at the deep spot this season ranged from **6.41** in the hypolimnion to **6.58** in the epilimnion, which means that the water is ***slightly acidic***.

It is important to point out that the pH in the hypolimnion (lower layer) was **lower (more acidic)** than in the epilimnion (upper layer). This increase in acidity near the lake bottom is likely due the decomposition of organic matter and the release of acidic by-products into the water column.

Due to the presence of granite bedrock in the state and acid deposition (from snowmelt, rainfall, and atmospheric particulates) in New Hampshire, there is not much that can be done to effectively increase lake/pond pH.

➤ **Table 5: Acid Neutralizing Capacity**

Table 5 (Appendix B) presents the current year and historical epilimnetic ANC for each year the lake/pond has been monitored through VLAP.

Buffering capacity (ANC) describes the ability of a solution to resist changes in pH by neutralizing the acidic input. The mean ANC value for New Hampshire's lakes and ponds is **6.6 mg/L**, which indicates that many lakes and ponds in the state are at least "moderately vulnerable" to acidic inputs. For a more detailed explanation, please refer to the "Chemical Monitoring Parameters" section of this report.

The mean Acid Neutralizing Capacity (ANC) of the epilimnion (the upper layer) was **5.3 mg/L** this season, which is **slightly less than** the state mean. In addition, this indicates that the lake/pond is **moderately vulnerable** to acidic inputs (such as acid precipitation).

➤ **Table 6: Conductivity**

Table 6 (Appendix B) presents the current and historical conductivity values for tributaries and in-lake data. Conductivity is the numerical expression of the ability of water to carry an electric current (which is determined by the number of negatively charged ions from metals, salts, and minerals in the water column). The mean conductivity value for New Hampshire's lakes and ponds is **59.4 uMhos/cm**. For a more detailed explanation, please refer to the "Chemical Monitoring Parameters" section of this report.

The mean annual conductivity in the epilimnion at the deep spot this season was **146.40 uMhos/cm**, which is **greater than** the state mean.

The conductivity continued to remain **much greater than** the state mean in the lake/pond and inlets this season. Typically, sources of increased conductivity are due to human activity. These activities

include septic systems that fail and leak leachate into the groundwater (and eventually into the tributaries and the lake/pond), agricultural runoff, and road runoff (which contains road salt during the spring snow melt). New development in the watershed can alter runoff patterns and expose new soil and bedrock areas, which could contribute to increasing conductivity. In addition, natural sources, such as iron and manganese deposits in bedrock, can influence conductivity.

We recommend that your monitoring group conduct stream surveys and storm event sampling along the inlet(s) with **elevated** conductivity so that we can determine what may be causing the increases.

*For a detailed explanation on how to conduct rain event sampling and stream surveys, please refer to the 2002 VLAP Annual Report “Special Topic Article” or contact the VLAP Coordinator.*

We also recommend that your monitoring group conduct a shoreline conductivity survey of the lake and the tributaries with **elevated** conductivity to help pinpoint the sources of **elevated** conductivity.

*To learn how to conduct a shoreline or tributary conductivity survey, please refer to the 2004 “Special Topic Article” in Appendix D of this report.*

It is possible that de-icing materials applied to nearby roadways during the winter months may be influencing the conductivity in the lake/pond. In New Hampshire, the most commonly used de-icing material is salt (sodium chloride).

***The epilimnion and Route 103 Inlet were sampled for chloride on the August sampling event. Please refer to the discussion of Table 14 for information regarding chloride sampling results.***

➤ **Table 8: Total Phosphorus**

Table 8 (Appendix B) presents the current year and historical total phosphorus data for in-lake and tributary stations. Phosphorus is the nutrient that limits the algae’s ability to grow and reproduce. Please refer to the “Chemical Monitoring Parameters” section of this report for a more detailed explanation.

The total phosphorus concentration was **elevated** in the **Hamel Brook** sample on the **August** sampling event (**36 ug/L**). The turbidity (Table 11) of the sample was also **elevated** (**22.3 NTUs**). This station has had a history of **elevated** and **fluctuating** phosphorus and turbidity concentrations which suggests that erosion is occurring in

this portion of the watershed.

Therefore, we recommend that your monitoring group conduct a stream survey and storm event sampling along this inlet. This additional sampling may allow us to determine what is causing the **elevated** levels of turbidity and phosphorus.

*For a detailed explanation on how to conduct rain event sampling and stream surveys, please refer to the 2002 VLAP Annual Report "Special Topic Article" or contact the VLAP Coordinator.*

➤ **Table 9 and Table 10: Dissolved Oxygen and Temperature Data**

Table 9 (Appendix B) shows the dissolved oxygen/temperature profile(s) for the 2004 sampling season. Table 10 (Appendix B) shows the historical and current year dissolved oxygen concentration in the hypolimnion (lower layer). The presence of dissolved oxygen is vital to fish and amphibians in the water column and also to bottom-dwelling organisms. Please refer to the "Chemical Monitoring Parameters" section of this report for a more detailed explanation.

The dissolved oxygen concentration was **lower in the hypolimnion (lower layer) than in the epilimnion (upper layer)** at the deep spot of the lake/pond. As stratified lakes/ponds age, and as the summer progresses, oxygen typically becomes **depleted** in the hypolimnion by the process of decomposition. Specifically, the loss of oxygen in the hypolimnion results primarily from the process of biological breakdown of organic matter (i.e.; biological organisms use oxygen to break down organic matter), both in the water column and particularly at the bottom of the lake/pond where the water meets the sediment. When oxygen levels are depleted to less than 1 mg/L in the hypolimnion (as it has been in previous seasons), the phosphorus that is normally bound up in the sediment may be re-released into the water column (a process referred to as **internal phosphorus loading**).

The **lower** oxygen level in the hypolimnion is a sign of the lake's/pond's **aging** and **declining** health. The biologist has conducted the temperature/dissolved oxygen profile during **August since 2001**. We recommend that the annual biologist visit for the 2005 sampling season be scheduled during **June or July** so that we can determine if oxygen is depleted in the hypolimnion **earlier** in the sampling season.

➤ **Table 11: Turbidity**

Table 11 (Appendix B) lists the current year and historical data for in-lake and tributary turbidity. Turbidity in the water is caused by suspended matter, such as clay, silt, and algae. Water clarity is strongly influenced by turbidity. Please refer to the “Other Monitoring Parameters” section of this report for a more detailed explanation.

As discussed previously, the turbidity of the hypolimnion (lower layer) sample was **elevated** on the **July** sampling event. This suggests that the lake/pond bottom may have been disturbed by the anchor or by the Kemmerer Bottle while sampling and/or that the lake bottom is covered by a thick organic layer of sediment which is easily disturbed.

In addition, the turbidity in the **Hamel Brook** samples in **July** and **August** was **elevated** which suggests that the stream bottom may have been disturbed while sampling or that erosion is occurring in this portion of the watershed.

➤ **Table 12: Bacteria (*E.coli*)**

Table 12 lists the current year and historical data for bacteria (*E.coli*) testing. (Please note that Table 12 now lists the maximum and minimum results for this season and for all past sampling seasons.) *E. coli* is a normal bacterium found in the large intestine of humans and other warm-blooded animals. *E.coli* is used as an indicator organism because it is easily cultured and its presence in the water, in defined amounts, indicates that sewage **MAY** be present. If sewage is present in the water, potentially harmful disease-causing organisms **MAY** also be present.

The *E.coli* concentration was **0 counts per 100 mL** in the **Cole Cottage** sample collected in **July** which is good news!

If residents are concerned about sources of bacteria such as failing septic systems, animal waste, or waterfowl waste, it is best to conduct *E. coli* testing when the water table is high, when beach use is heavy, or immediately after rain events.

➤ **Table 13: Chloride**

The chloride ion (Cl<sup>-</sup>) is found naturally in some surfacewaters and groundwaters and in high concentrations in seawater. Research has shown that **elevated** chloride levels can be toxic to freshwater aquatic life. In order to protect freshwater aquatic life in New Hampshire, the state has adopted acute and chronic chloride criteria of 860 and 230 mg/L respectively. The chloride content in New Hampshire lakes is naturally low, generally less than 2 mg/L in surface waters located in remote areas away from habitation. Higher values are generally

associated with salted highways and, to a lesser extent, with septic inputs. Please refer to the “Chemical Monitoring Parameters” section of this report for a more detailed explanation.

The **epilimnion** and **Route 103 Inlet** were sampled for chloride on the August sampling event. The chloride results were **33 mg/L** and **3 mg/L**, respectively, which is **less than** the state acute and chronic chloride criteria.

We recommend that your monitoring group continue to conduct chloride sampling in the **epilimnion** at the deep spot and the **Route 103 Inlet**, particularly in the spring soon after snow-melt and after rain events during the summer. This will establish a baseline of data which will assist your monitoring group and DES in determining lake quality trends in the future.

*Please note that there will be an additional cost for each of the chloride samples and that these samples must be analyzed at the DES Laboratory.*

*In addition, please read this year's Special Topic Article, “Conductivity is on the rise in New Hampshire's Lakes and Ponds: What is causing the increase and what can be done?” which is found in Appendix D of this report. This article may help your association understand what types of activities can lead to elevated conductivity and chloride levels and what residents can do to minimize this type of pollution.*

➤ **Table 14: Current Year Biological and Chemical Raw Data**

This table is a new addition to the Annual Report. This table lists the most current sampling season results. Since the maximum, minimum, and annual mean values for each parameter are not shown on this table, this table displays the current year “raw” (meaning unprocessed) data. The results are sorted by station, depth zone (epilimnion, metalimnion, and hypolimnion) and parameter.

➤ **Table 15: Station Table**

This table is a new addition to the Annual Report. As of the Spring of 2004, all historical and current year VLAP data are included in the DES Environmental Monitoring Database (EMD). To facilitate the transfer of VLAP data into the EMD, a new station identification system had to be developed. While volunteer monitoring groups can still use the sampling station names that they have used in the past (and are most familiar with), an EMD station name also exists for each VLAP sampling location. For each station sampled at your lake or pond, Table 15 identifies what EMD station name corresponds to

the station names you have used in the past and will continue to use in the future.

### **DATA QUALITY ASSURANCE AND CONTROL**

#### **Annual Assessment Audit:**

During the annual visit to your lake/pond, the biologist conducted a “Sampling Procedures Assessment Audit” for your monitoring group. Specifically, the biologist observed the performance of your monitoring group while sampling and filled out an assessment audit sheet to document the ability of the volunteer monitors to follow the proper field sampling procedures (as outlined in the VLAP Monitor’s Field Manual). This assessment is used to identify any aspects of sample collection in which volunteer monitors fail to follow proper procedures, and also provides an opportunity for the biologist to retrain the volunteer monitors as necessary. This will ultimately ensure that the samples that the volunteer monitors collect are truly representative of actual lake and tributary conditions.

Overall, your monitoring group did an **excellent** job collecting samples on the annual biologist visit this season! Specifically, the members of your monitoring group followed the proper field sampling procedures and there was no need for the biologist to provide additional training. Keep up the good work!

#### **Sample Receipt Checklist:**

Each time your monitoring group dropped off samples at the laboratory this summer, the laboratory staff completed a sample receipt checklist to assess and document if the volunteer monitors followed proper sampling techniques when collecting the samples. The purpose of the sample receipt checklist is to minimize, and hopefully eliminate, future re-occurrences of improper sampling techniques.

Overall, the sample receipt checklist showed that your monitoring group did an **excellent** job when collecting samples and submitting them to the laboratory this season! Specifically, the members of your monitoring group followed the proper field sampling procedures and there was no need for the laboratory staff to contact your group with questions, and no samples were rejected for analysis.

**USEFUL RESOURCES**

*Best Management Practices to Control Nonpoint Source Pollution: A Guide for Citizens and Town Officials*, NHDES Booklet WD-03-42, (603) 271-2975.

*Best Management Practices for Well Drilling Operations*, NHDES Fact Sheet WD-WSEB-21-4, (603) 271-2975 or [www.des.nh.gov/factsheets/ws/ws-21-4.htm](http://www.des.nh.gov/factsheets/ws/ws-21-4.htm).

*Canada Geese Facts and Management Options*, NHDES Fact Sheet BB-53, (603) 271-2975 or [www.des.state.nh.us/factsheets/bb/bb-53.htm](http://www.des.state.nh.us/factsheets/bb/bb-53.htm).

*Cyanobacteria in New Hampshire Waters Potential Dangers of Blue-Green Algae Blooms*, NHDES Fact Sheet WMB-10, (603) 271-2975 or [www.des.state.nh.us/factsheets/wmb/wmb-10.htm](http://www.des.state.nh.us/factsheets/wmb/wmb-10.htm).

*Erosion Control for Construction in the Protected Shoreland Buffer Zone*, NHDES Fact Sheet WD-SP-1, (603) 271-2975 or [www.des.state.nh.us/factsheets/sp/sp-1.htm](http://www.des.state.nh.us/factsheets/sp/sp-1.htm).

*IPM: An Alternative to Pesticides*, NHDES Fact Sheet WD-SP-3, (603) 271-2975 or [www.des.state.nh.us/factsheets/sp/sp-3.htm](http://www.des.state.nh.us/factsheets/sp/sp-3.htm).

*Iron Bacteria in Surface Water*, NHDES Fact Sheet WD-BB-18, (603) 271-2975 or [www.des.state.nh.us/factsheets/bb/bb-18.htm](http://www.des.state.nh.us/factsheets/bb/bb-18.htm).

*Lake Foam*, NHDES Fact Sheet WD-BB-4, (603) 271-2975 or [www.des.state.nh.us/factsheets/bb/bb-5.htm](http://www.des.state.nh.us/factsheets/bb/bb-5.htm).

*Road Salt and Water Quality*, NHDES Fact Sheet WD-WMB-4, (603) 271-2975 or [www.des.state.nh.us/factsheets/wmb/wmb-4.htm](http://www.des.state.nh.us/factsheets/wmb/wmb-4.htm).

*Sand Dumping - Beach Construction*, NHDES Fact Sheet WD-BB-15, (603) 271-2975 or [www.des.state.nh.us/factsheets/bb/bb-15.htm](http://www.des.state.nh.us/factsheets/bb/bb-15.htm).

*Soil Erosion and Sediment Control on Construction Sites*, NHDES Fact Sheet WQE-6, (603) 271-2975 or [www.des.state.nh.us/factsheets/wqe/wqe-6.htm](http://www.des.state.nh.us/factsheets/wqe/wqe-6.htm).

*Through the Looking Glass: A Field Guide to Aquatic Plants*, North American Lake Management Society, 1988, (608) 233-2836 or [www.nalms.org](http://www.nalms.org).

*Weed Watchers: An Association to Halt the Spread of Exotic Aquatic Plants*, NHDES Fact Sheet WD-BB-4, (603) 271-2975 or [www.des.state.nh.us/factsheets/bb/bb-4.htm](http://www.des.state.nh.us/factsheets/bb/bb-4.htm).